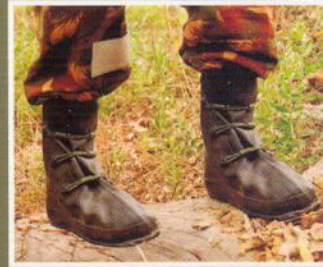


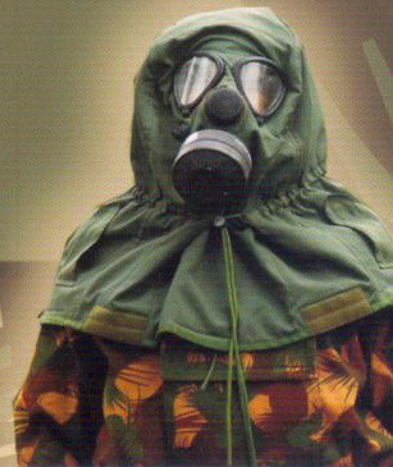


DEFENCE AGAINST CHEMICAL AND BIOLOGICAL AGENTS



ASHISH KUMAR SEN

Defence Research &
Development Organisation
Ministry of Defence
India



**DEFENCE AGAINST CHEMICAL AND
BIOLOGICAL AGENTS**

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Ashish Kumar Sen

Emeritus Scientist

Defence Materials & Stores Research & Development
Establishment, Kanpur



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PREFACE AND ACKNOWLEDGEMENTS

Nuclear, biological, and chemical (NBC) warfare are the weapons of mass destruction, chemical and biological warfare is the new threat. They are easy to produce, and inexpensive. Although, chemical and biological agents do not cause total destruction as in the case of nuclear attack, they have horrific effect on human beings and animals, leading to death. In 1925, the International Protocol in Geneva, prohibited the use of poisonous gases and biological agents for warfare. The protocol solved only the use of these agents in war but not their production and storage. Later in 1972, Biological Agent and Toxin Weapons Convention prohibited the development, production and stockpiling of biological and toxin weapons. Chemical weapons convention of 1993 has banned producing, stockpiling, and use of chemical warfare agents. Though banned by treaty, there is evidence that chemical and biological warfare is regarded as legitimate means of attack by number of countries. Moreover, several countries stockpile them not for first strike, but for retaliation. Such warfare affects both military and civilian population. A major cause of concern is the use of these agents against civilians by terrorists. Intensive research is being carried out the worldover on various aspects of protection including personal protection, decontamination, and detection, leading to spurt in research publications and patents.

The present book is aimed at creating a general awareness of the effect of chemical and biological warfare and the various means of protection. An overview of the research trends have also been described. The book consists of nine chapters. Historical background has been given in Chapter 1. Various chemical warfare agents, their classes, physiological effect on humans, pretreatment and therapy have been dealt with in Chapter 2. Chapter 3 describes all the potential biological warfare agents, including bacteria, virus and toxins, the disease they produce and type of medical aid. Delivery of these agents is discussed in chapter 4. The personal equipment have to be decontaminated after an attack to prevent fresh casualty. Different techniques of decontamination system and equipment have been described in Chapter 5. Protection from these agents are of prime importance for the safety of the individual. Chapter 6 presents protective equipment for individual including respirator, suits and shelters for collective protection. Detectors used in battlefield to warn the soldiers in the battlefield, as well as civilians of an impending attack of chemical and biological agents are included in Chapter 7 and 8 respectively. In Chapter 9, test methods for protective clothing have been described.

I am grateful to Defence Scientific Information and Documentation Centre (DESIDOC), Ministry of Defence, Government of India, for granting me a project to

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October 2009
Kanpur

AK Sen

CHAPTER 1

Historical Background

1.1 INTRODUCTION

Weapons of mass destruction (WMD) are the weapons that can kill a large number of human beings and/or cause great damage to man-made or natural structures, or the biosphere, in general. The term covers nuclear, biological, and chemical weapons. During the cold war, WMD were mainly referred to nuclear weapons. Nuclear weapons were developed in the Manhattan Project, USA. These are completely indiscriminate due to their explosive power, heat, and radioactivity. The extent of destruction has been demonstrated by the atom bombs dropped in two cities of Japan – Hiroshima and Nagasaki in August 1945. Nuclear weapons are rarely used for fear of retaliation, which in turn could escalate in a war so destructive as to wipe out large segments of human population¹.

Chemical and biological weapons are new forms of threats. In a conventional war, the damage is due to the kinetic energy of bullets or metal fragments derived from the explosion of chemicals. In a chemical warfare, the casualty is caused by temporary loss of performance, permanent injury or death of human beings and animals, caused by the toxicity of the chemicals. On the other hand, biological warfare is the intentional use of microbes for producing disease or death in men, animals, and crops. A chemical or biological attack would create a battlefield wasteland, where affected human beings would be absent but the buildings and infrastructure would be left intact. Occupying forces could then takeover the territory unopposed, by decontamination². A brief historical background of chemical and biological weapons is given in this chapter.

1.2 EARLY HISTORY

The use of biological and chemical weapons dates back to ancient times²⁻⁵. Contamination of drinking water sources by poisonous materials was first reported in 600 BC. Deliberate use of germs for spreading disease to the enemy was in practice since time immemorial. Corpses of cholera and plague victims were dropped over the walls of the besieged city to infect the population. It was also common practice for retreating armies to indulge in scorched earth tactics and poisoning of drinking water.

The use of burning Sulphur and pitch to cause asphyxiation and irritation dates back from 4th century BC. The use of poisonous smoke to disable the enemy was

practised till middle ages. Greek fire used in AD 660 as a naval weapon, consisted of resin, pitch, Sulphur, naphtha, and lime. The fire would float in water and set fire to the wooden ships of that era.

1.3 WORLD WAR I

In modern times, the use of toxic chemicals originated in the First World War. In October 1914, tear gas was unsuccessfully used against the French forces in the battle of Neuve Chapelle. This was followed by the discharge of shells containing lachrymator xylyl bromide in January 1915 against the Russians in the eastern front. The sub-zero condition at that time caused the chemical to freeze, rendering it ineffective. The introduction of gas as an effective weapon dates back from 22nd April 1915, when the Germans fired 150 tonne of chlorine from special cylinders in the battle at Ypres-Belgium. The attack was a success far beyond the expectations, and caused two French divisions to panic. Later, the attack was directed against British and Canadian forces. These former attacks produced 'gas hysteria' and the latter provoked fear among those exposed to such agents. Prof Fritz Haber was Chief of German Chemical Warfare Service during World War I and is often referred to as Father of Chemical Warfare. As the war continued, many toxic compounds besides chlorine, were tested for utility as chemical warfare agents. Of the various chemical agents tried - chlorine, phosgene, diphosgene, chloropicrin, hydrogen cyanide, cyanogen chloride, and mustard were produced and used in large quantities. In July 1917, the Germans began using mustard gas which caused several slow-healing blisters on the skin and damage the respiratory tract. It was difficult to provide effective protection against this agent which accounted for most of the casualties during that time²⁻⁵.

Simultaneous to the development of more lethal chemical agent, both sides worked to develop more effective methods of agent delivery. The release of gases from cylinders was prone to the direction of wind, if the wind shifted shortly after release, the gas would blow back on the attacking force. Several new means of delivering chemical warfare agents by shells from mortars and artillery were introduced. The British developed Liven's projector that could throw shells of 1.5 gallons chlorine or phosgene^{2,3}.

Gas was used by both Germans and Allies in the World War I. A total of 1,25,000 tonne of different chemical warfare agents were used in the battlefield causing about 90,000 fatalities and 1.2 million non-fatal injuries. Gas was a major cause of casualty in the war and resulted in 30 per cent hospitalisation cases. The effect of gas is insidious, causes casualty without warning. It exerts tremendous effect on the morale of the troops and is a major problem due to long hospitalisation periods^{2,3}. It is arguable whether chemical warfare was more or less horrific than a conventional war.

Development of protective equipment, particularly protective mask kept pace with development of CW agent. The early masks developed by Germany, UK, and France were pads soaked with sodium bicarbonate and sodium thiosulphate with charcoal in between the layers. Later, box respirators were developed in which the mask was connected to a canister filled with protective chemicals and filters and carried in a canvas pouch. With the advent of mustard, decontamination procedures like shower were adopted and contaminated clothing handled by wearing masks and protective clothing made of oilcloth⁵.

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About The Author

AK Sen obtained his Master's degree in Chemistry in 1957, M.Tech in 1958 and Doctorate in Applied Chemistry in 1963 from Indian Institute of Technology (IIT), Kharagpur, India. He was faculty member of the Chemistry Department of IIT, Kharagpur from 1963 to 1971. He was a post-doctoral fellow at State University of New York, Stonybrook, from 1967 to 1968. He later joined Defence Materials and Stores Research and Development Establishment, Kanpur, India, as a research scientist. He worked in the fields of polymer science – characterization of polymers and blends by inverse gas chromatography, chemical process development, and special textile and clothing for the Services. He has been involved in the successful development and bulk production of clothing for extreme cold and for chemical protection. For his contributions, he was awarded the Defence R&D Organisations's Technology Award in 1996. The books written by him include: Coated Textiles: Principles and Applications (2001), Ed.2 (2007) and Inverse Gas Chromatography (2005). He is presently Emeritus Scientist at Defence Materials and Stores Research and Development Establishment, Kanpur, India.

About the Book

Nuclear, biological and chemical (NBC) warfare weapons are the weapons of mass destruction, chemical and biological warfare is the new threat. These warfare agents are easy to produce and are inexpensive. Although, chemical and biological agents do not cause total destruction as in the case of nuclear attack, they have horrific effects on humans and animals, leading to their death. A major cause of concern is the use of these agents against the civilian population by the terrorists.

The present book is aimed at creating general awareness about the effects of chemical and biological warfare agents and the various means of protection. The book consists of nine chapters and the topics include: Chemical warfare agents, their classes, physiological effect on humans, pre-treatment and therapy, potential biological warfare agents, the diseases they cause and their delivery, different techniques of decontamination systems, protection, detectors used in battlefield to warn the soldiers in the battlefield, as well as civilians of an impending attack, and test methods for protective clothing have been described.

This monograph would be an advanced primer to higher level researchers committed to detect and protect both military and the masses from these dangerous agents.

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